Portraying the Earth

Chapter 2

The Nature of Maps

- How and why do we describe the earth using maps?
- When we need **to understand the world** around us we use maps
- A map is a **two or three-dimensional representation** of the Earth and a **spatial distribution of selected phenomena**– normally the components of a landscape.
- The **basic attributes** of a map
  - Show **direction, distance, size, and shape**
    - **Spatial relationships of features** of the earth
- Maps have a special purpose

Map Scale

- **The scale of a map gives the relationship between length measured on the map and corresponding actual distance on the ground**.

- **Scale types**

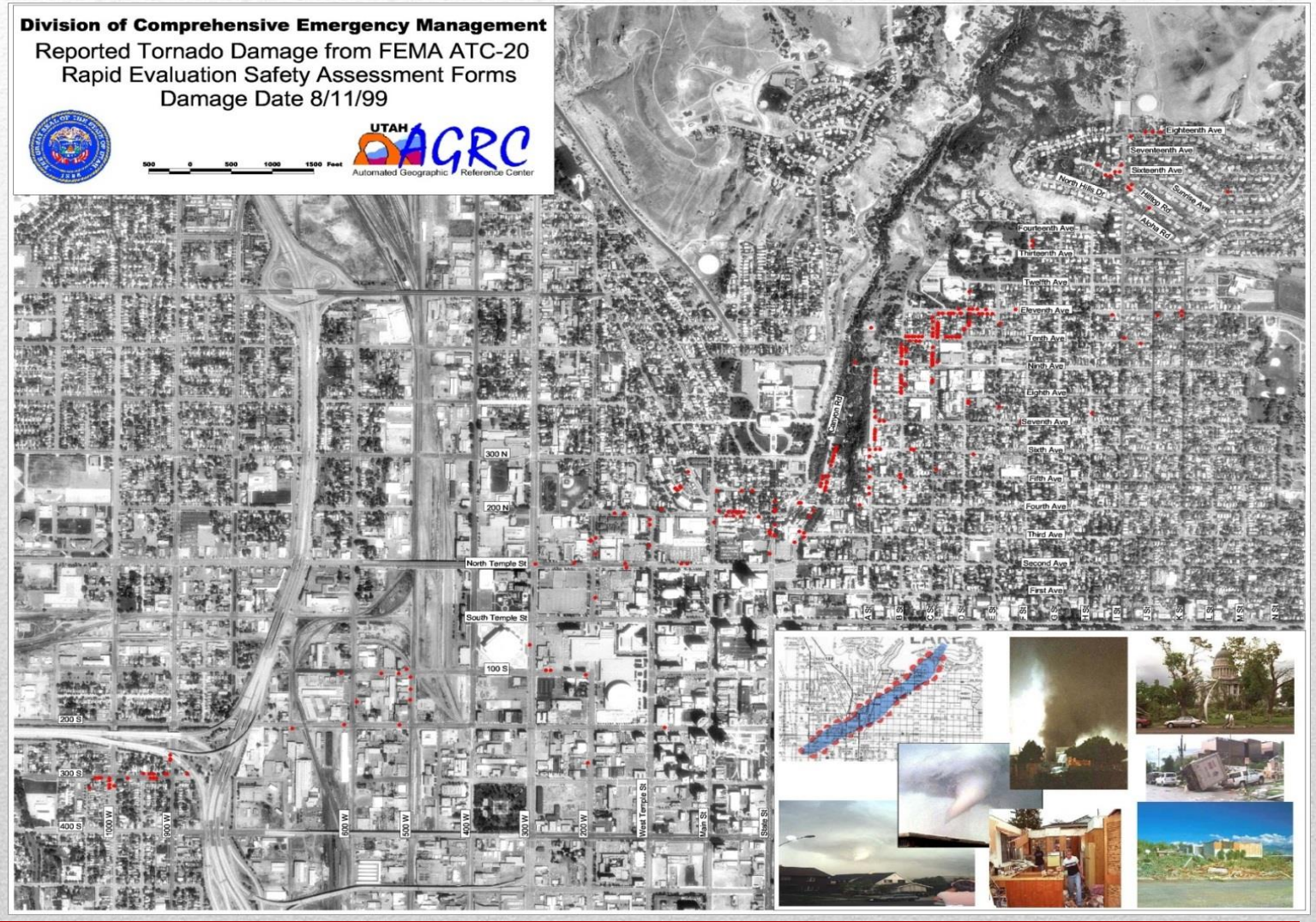
  - ***Graphic Map Scale*** uses **a line marked off in graduated distances**.
  - ***Fractional Map Scale*** compares map distance with ground distance in a proportional fraction or ratio called a **representative fraction.**
  - ***Verbal Map Scale* or *word scale,*** state **in words** the ratio of the map scale length to the actual distance on the Earth's surface.

Large Scale and Small Scale

- **Large Scale Maps**
  - Large representative fraction, or the **denominator is small**. **1:10,000**
  - See **more detail** in the map
  - Portrays a **smaller area** of the earth

- **Small Scale Maps**
  - Small representative fraction, or the **denominator is large**, 1:1,000,000
  - See **less detail** in the map
  - Portrays a **large area** of the earth

Large Scale Map



Small Scale Map

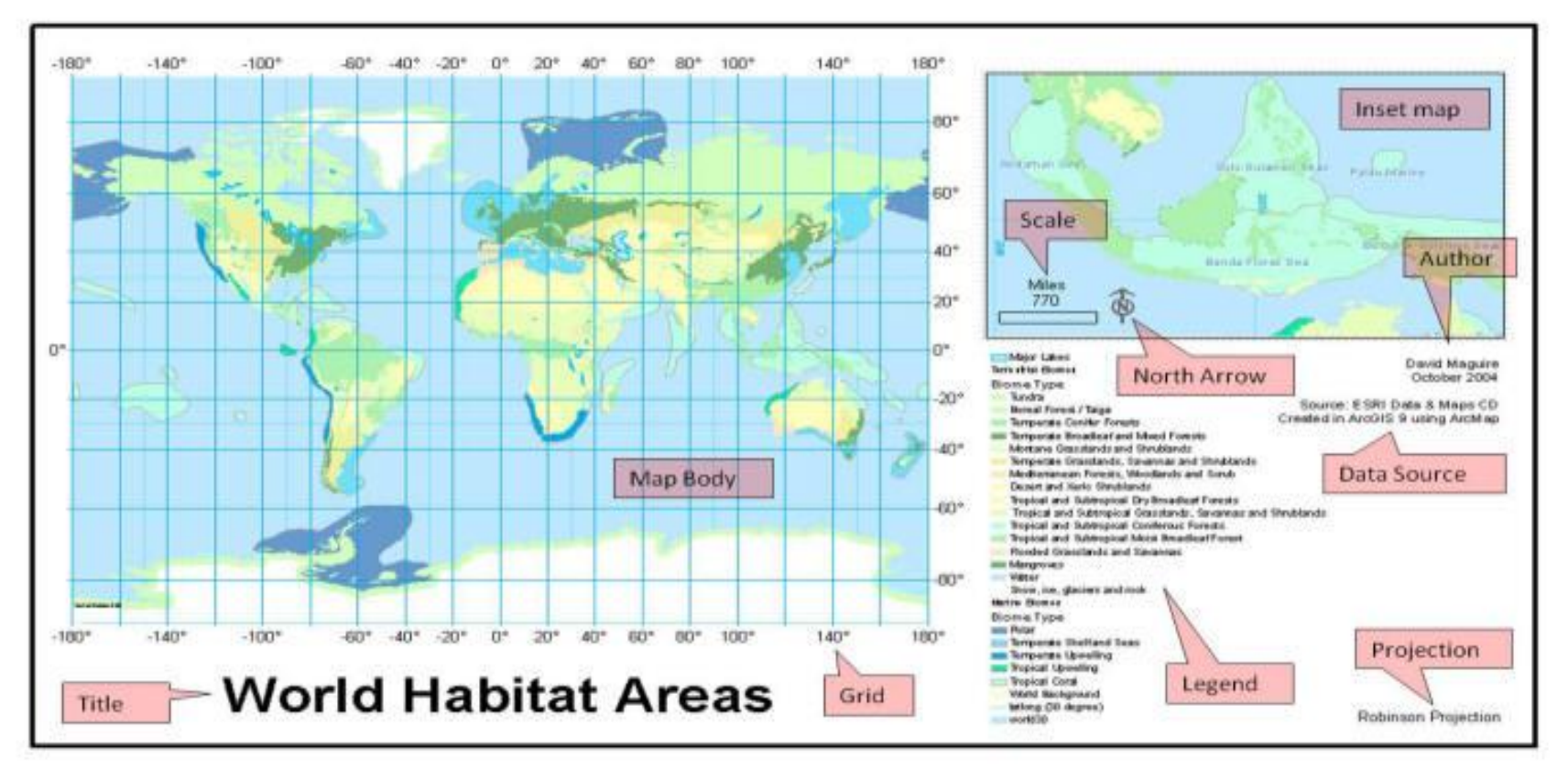
Map Essentials - Components of a Map

- **Title**: short brief summary of map's contents
- **Date**: should be the date of the compilation of the data found on the map.
  - Can also be the date of the data found on the map
- **Legend**: information about the symbols colors, and such used to depict the features of the map
- **Scale**: if map is more than a pictogram. Scale can be either graphic, verbal, for fractional.

Map Essentials – Components of a Map

- **Direction: a north arrow** (top of the map, should be north). If there is a grid, there should still be a north arrow.
- **Location:** grid, such as latitude and longitude, to be used to locate features
- **Data Source**: source of the data found on the map
- **Projection type**: in what projection is the data on the map

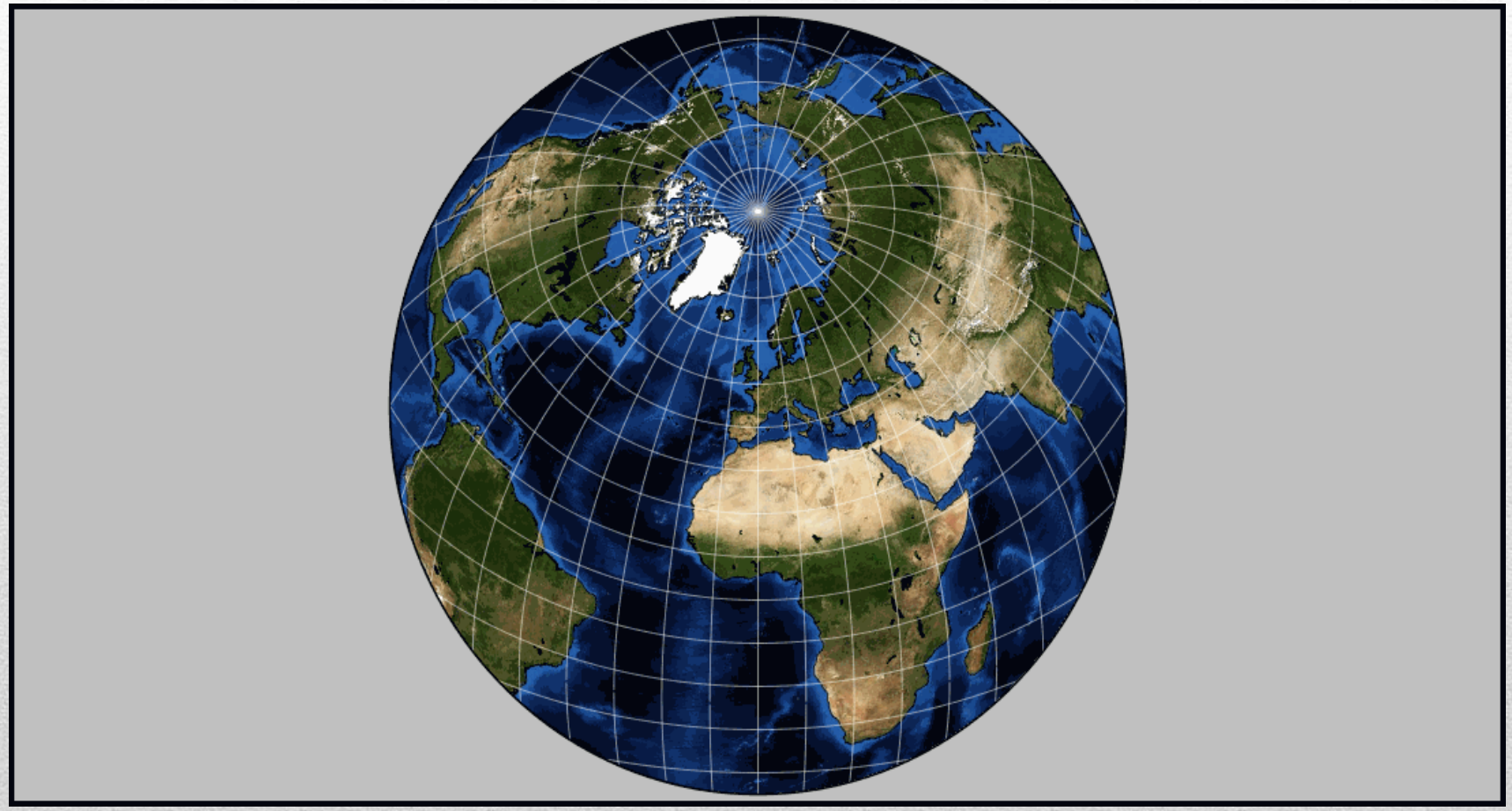
Map Essentials - Components of a Map



Globes

- **Best substitute** for depicting the earth
- The only thing changed in depicting the earth onto a globe is the **size**
- Shows comparative **distances, sizes, and accurate directions.**
- **Represents without distortion**, the spatial relationships of features of the earth
- **Problem, because the globe will be set a very small scale** (detail is lost)

Globes



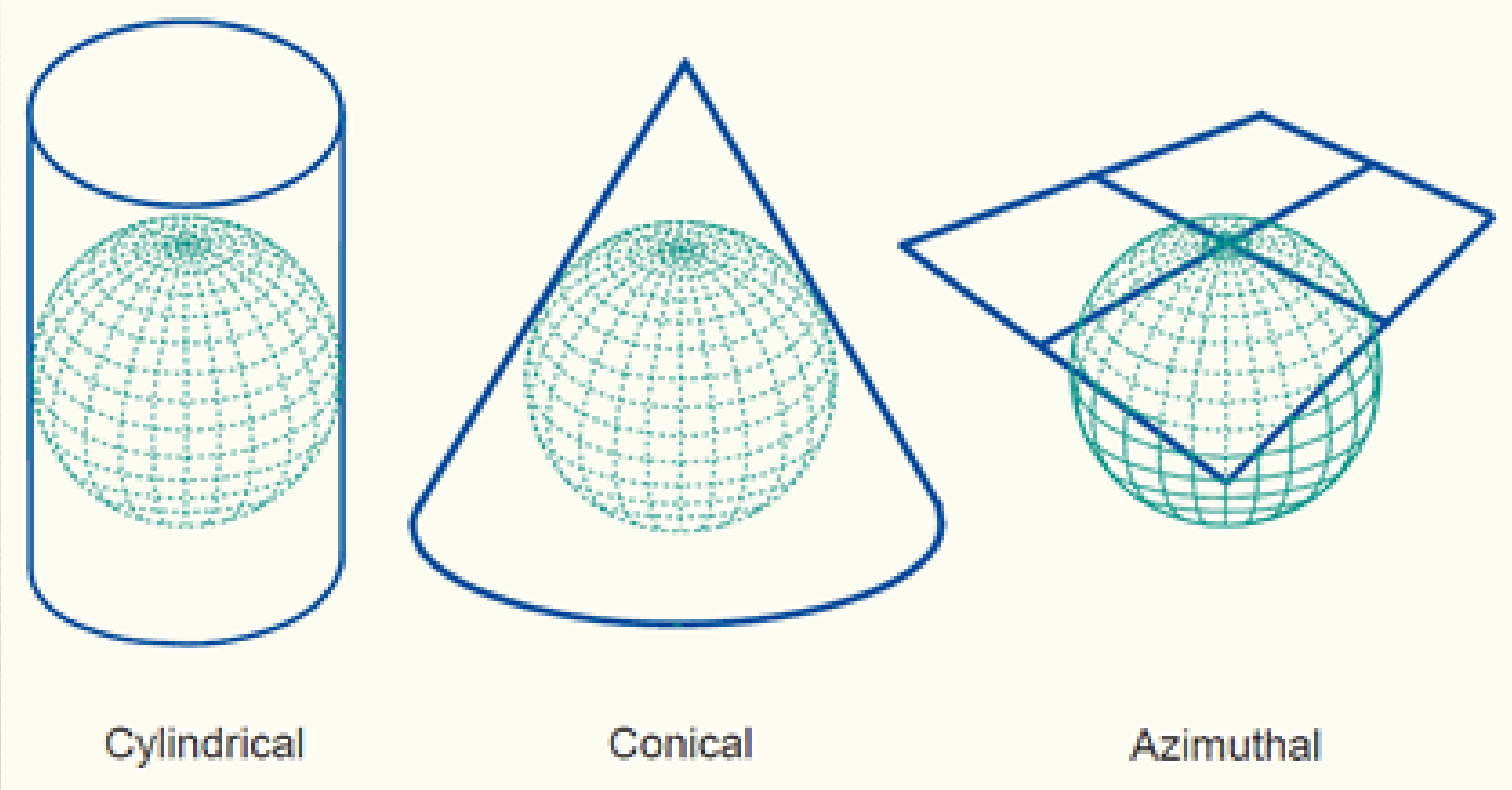
Map Projections

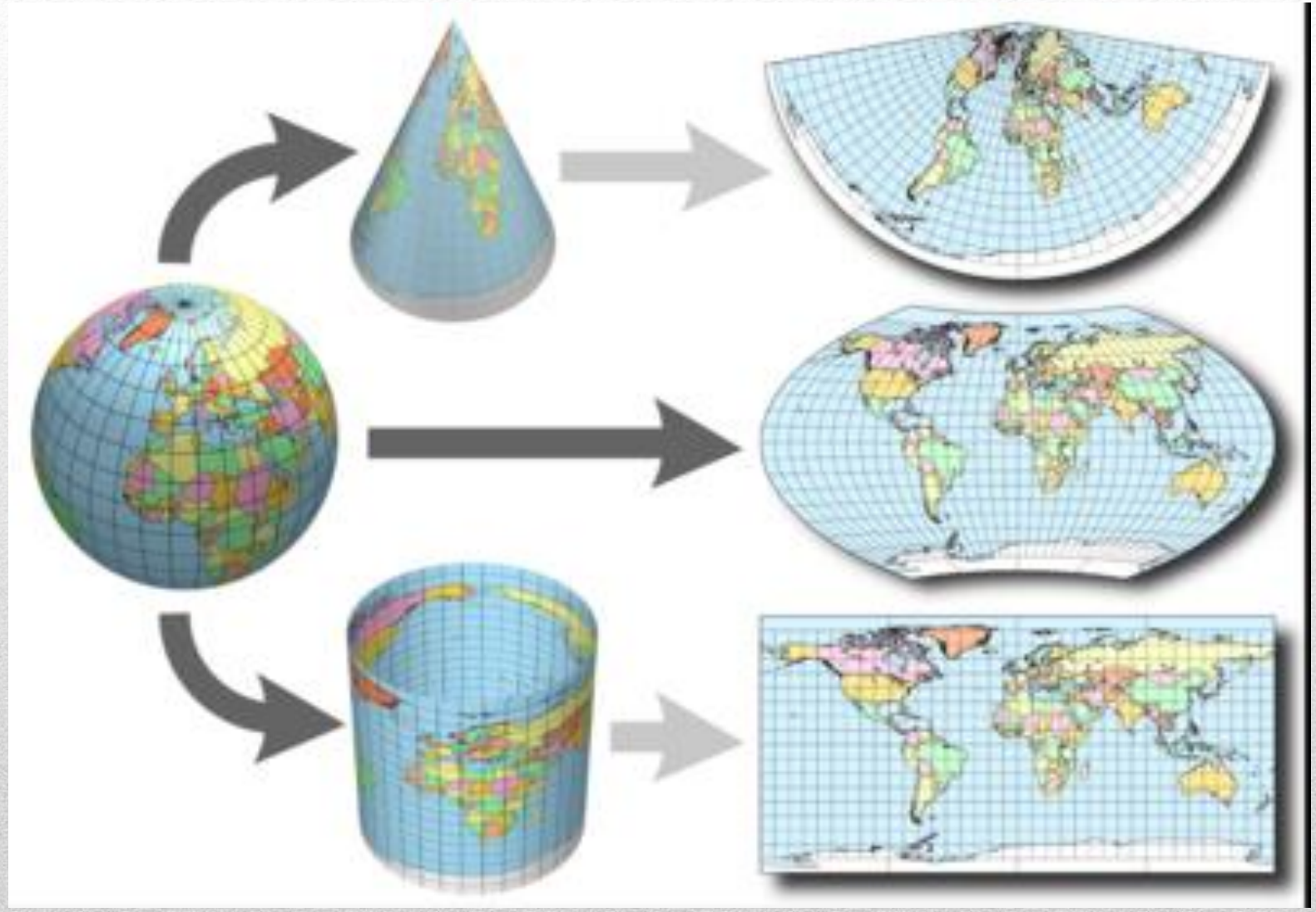
- A system whereby the **spherical surface of the earth is transformed to display on a flat surface**.

- **Three basic projection styles** for the earth
  - **Cylinder**
  - **Cone**
  - **Flat or Planar or Tangent**

- Using a globe inside the Earth with each style, the lines or features are transferred to the paper

Map Projections

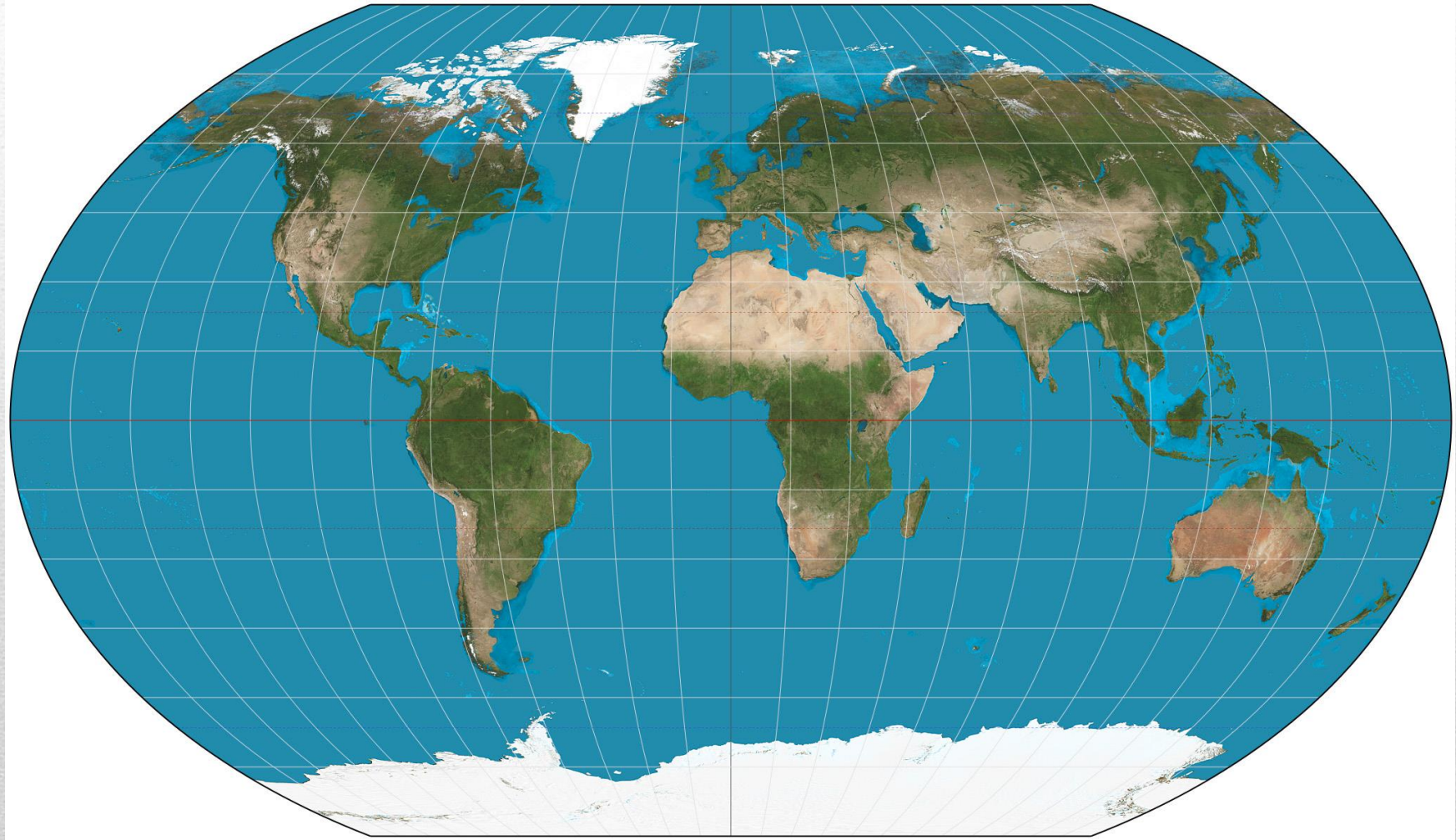




Equivalence versus Conformity

- **Equivalence Projection – equal area projection**
  - The **size ratio of any area on the map to the corresponding area on the ground** is the same all over the map
  - **Desirable because misleading impressions are avoided.**
  - **Difficulty to achieve on small-scale maps**, to maintain proper areal relationships

Equivalence Projection



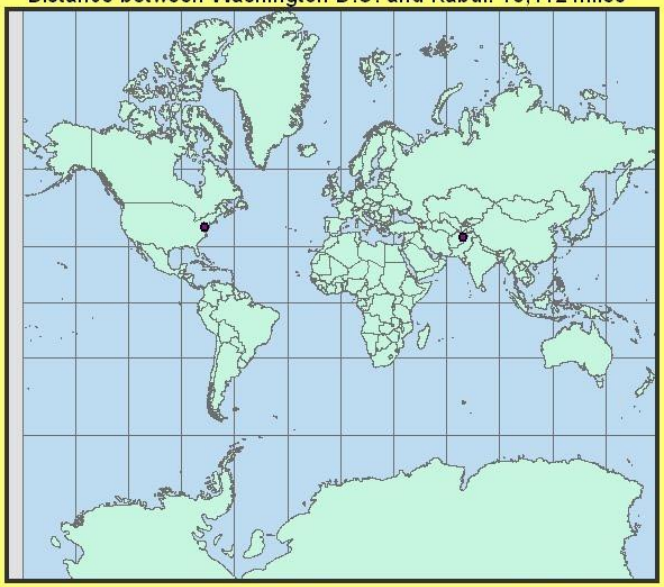
Equivalence versus Conformity

- **Conformal Projection – conformal relations**
  - Proper angular relationships are maintained so that the **shape of something on the map is the same as its shape on the Earth**
  - **Meridians and Parallels cross each other at right angles**.
  - Most notable projection is probably the ***Mercator*** **projection**.
  - A ***Robinson*** **projection** is a compromise between a equivalence and conformality.

Conformal Map Projections

Mercator Projection

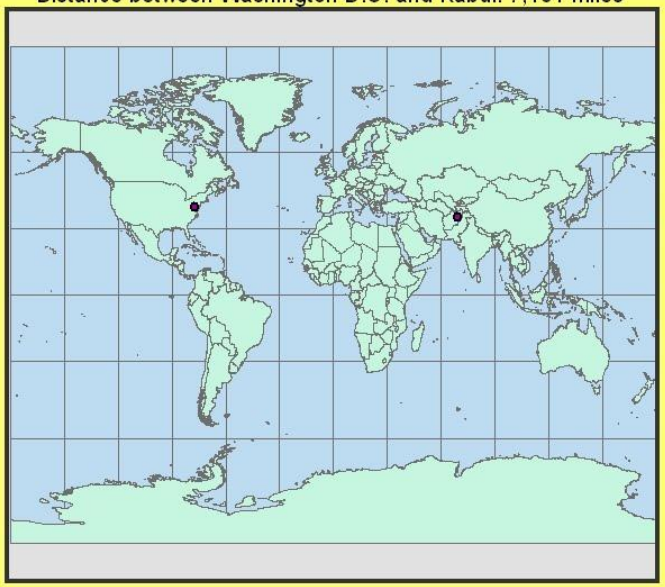
Distance between Washington D.C. and Kabul: 10,112 miles



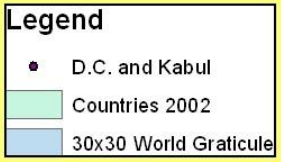
0 4,400 8,800 17,600 Miles

Gall Stereographic Projection

Distance between Washington D.C. and Kabul: 7,151 miles



0 3,100 6,200 12,400 Miles



*Actual Approximated Distance Between Washington D.C. and Kabul: 6,930 miles

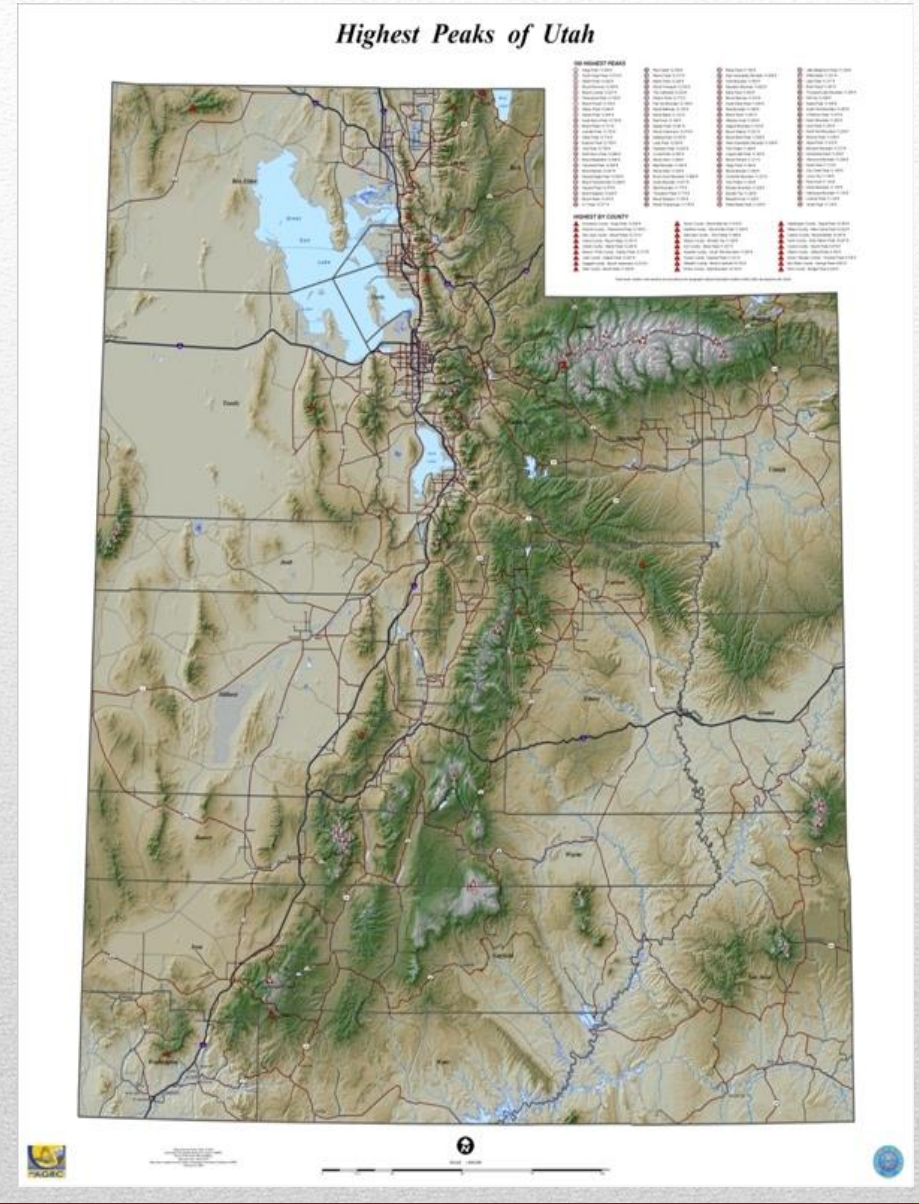
Projections

- **Mercator**, the most famous Projection
  - Developed in 1569 by Flemish geography and cartographer, **Gerhardus Mercator**
  - Developed for **use in navigation of ships**
  - Advantage: shows ***Loxodromes*** *or* ***Rhumb lines*** as straight lines.
  - **Problems with the Mercator**,
    - **Extreme East-West distortion in higher latitudes**
    - To compensate **Mercator stretched the spacing** north and south to compensate.
    - Allowed shapes to **be reasonably accurate but proper size relationships distorted**

Mercator Projection

Projections

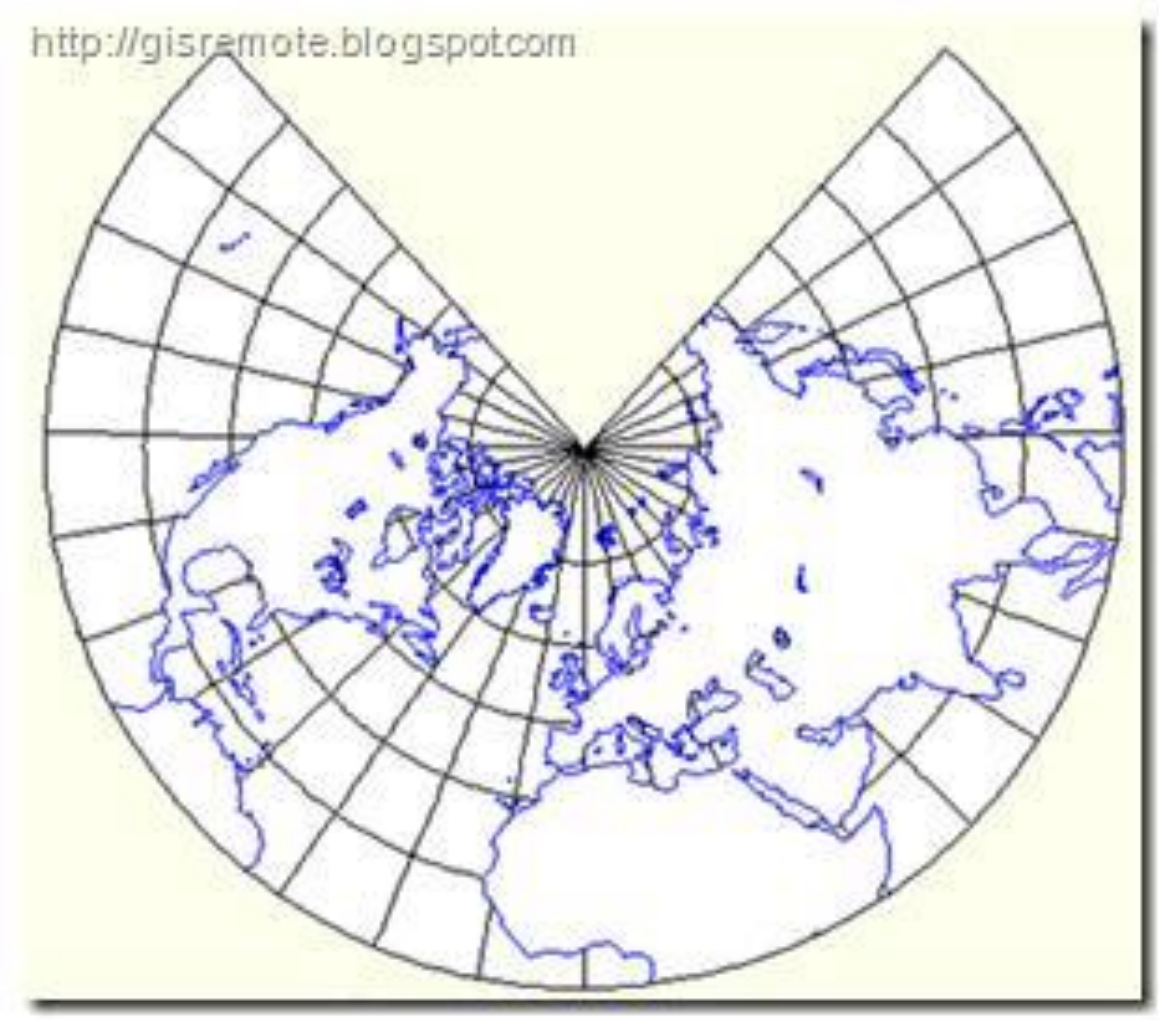
- The **Plane projection – *azimuthal or zenithal projection.***
  - Obtained by **projecting markings of the globe on a flat piece of paper that is tangent** to one point of the globe
  - **Used often in large scale maps** or small areas of the globes
  - **Usually is shown from either the North Pole or the South Pole**


Highest Peaks of Utah

Projections

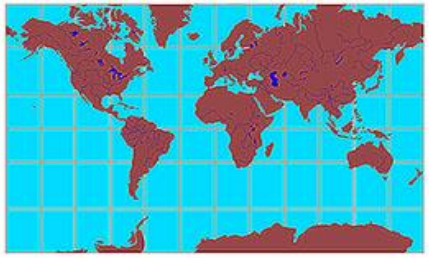
- The **Conic Projection**
  - Obtained by **projecting the markings of the globe onto a cone wrapped tangent to or intersecting a portion of the globe**
  - Normally the **apex of the cone is positioned about a pole** which means the circle of tangency coincides with a parallel.
  - Best suited for regions of **east-west orientation in the mid latitudes.**

Conic Projections

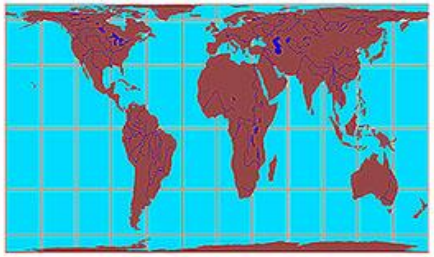


Funky Projections

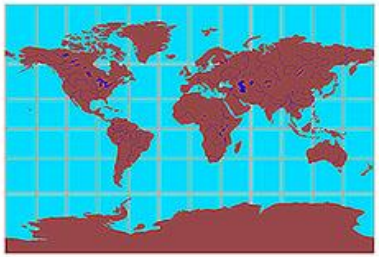
- **Pseudocylindrical projection** – elliptical or oval projection
  - Football shape of usually the whole world
- **Interrupted projections**
  - Most famous – ***Goode's interrupted homolosine projection***



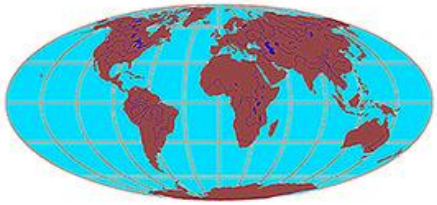
Mercator Projection



Gall-Peters Projection



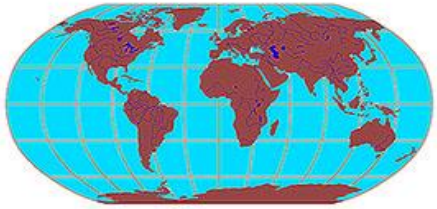
Miller Cylindrical Projection



Mollweide Projection

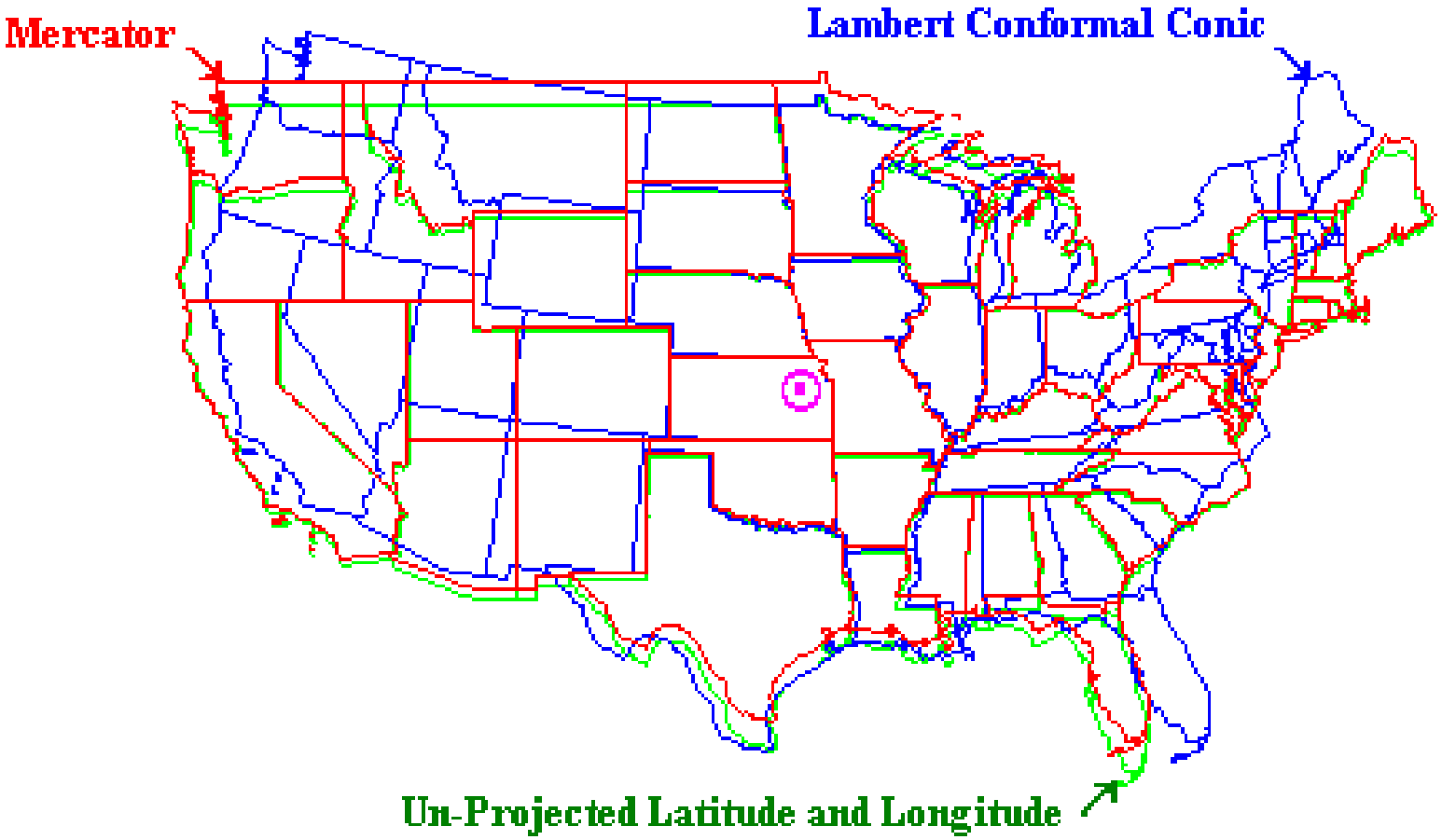
Goode's Homolosine Equal-area Projection

Sinusoidal Equal-Area Projection



Robinson Projection

Three Map Projections Centered at 39 N and 96 W



Peter H. Dana 6/23/97

Computer Cartography

- Using **computers to create maps**
  - **Symap** (first software used to make maps
    - **1965**
  - **Global Positioning Systems**
  - **Remote Sensing**
  - **Imagery**
  - **Multi-spectral Remote Sensing**
  - **Geographic Information Systems**
- Widely used today
- Expanding industry

Isolines

- **<u>Portray the spatial distribution of some phenomenon on the earth</u>**

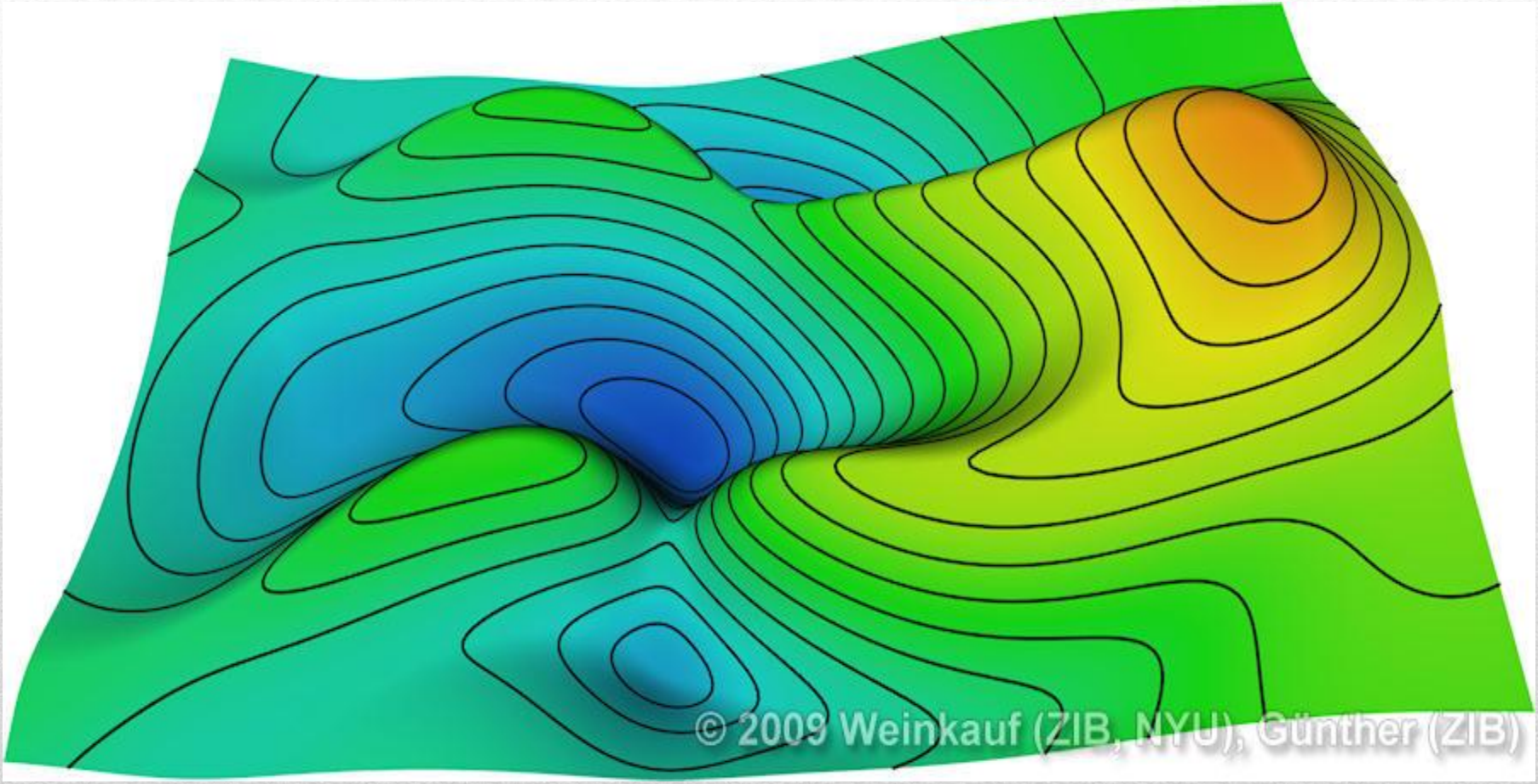
  - **Isarithm, isogram, isopleth, and isometric lines** are synonymous for our purposes

  - Most important to physical geography
    - **Elevation Contour Line** – depicts elevation
    - **Isotherm** – depicts equal temperature
    - **Isobar** – depicts equal atmospheric pressure
    - **Isohyet** – depicts equal quantities of precipitation
    - **Isogonic Line** – depicts equal magnetic declination

Characteristics of Isolines

- **Always closed lines-** is line comes to the end of a map the line probably proceeds to the next area
- Represent **gradations in quantity, never touch or cross one another**
- **Numerical difference** between one isoline and another **is an interval**.
- Isolines **close together indicate a steep gradient, those far apart indicate a gentle gradient**.

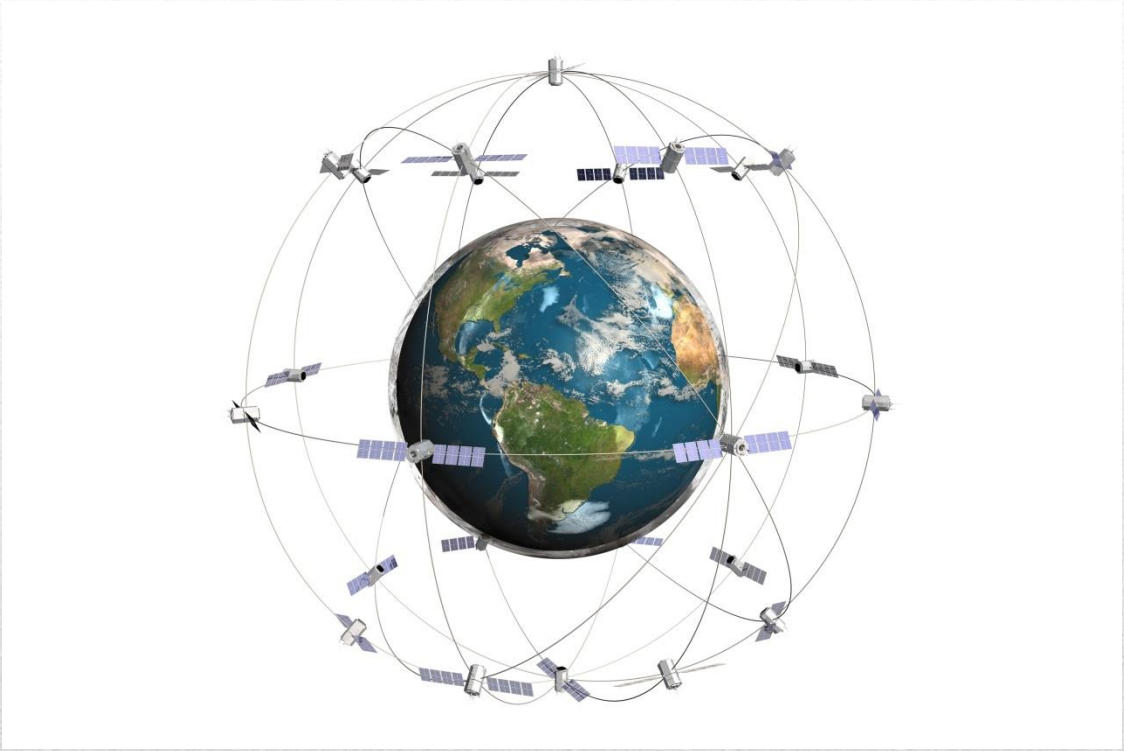
Isolines

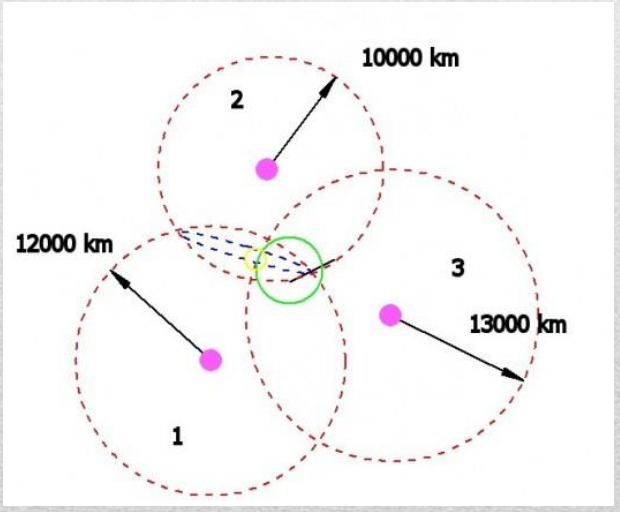


Global Positioning System (GPS)

- A **satellite based system for determining** accurate **positions** on or near the Earth's surface.
- **Developed in the 1970's** for the military
- Based on **24 high-altitude satellites** configured so that a **minimum of 4 satellites** are in view of any position on the Earth.
- Each **satellite continuously transmits both identification and positioning information** that can be picked up by receivers on Earth.
- **Position determined through triangulation**.

Global Positioning System (GPS)

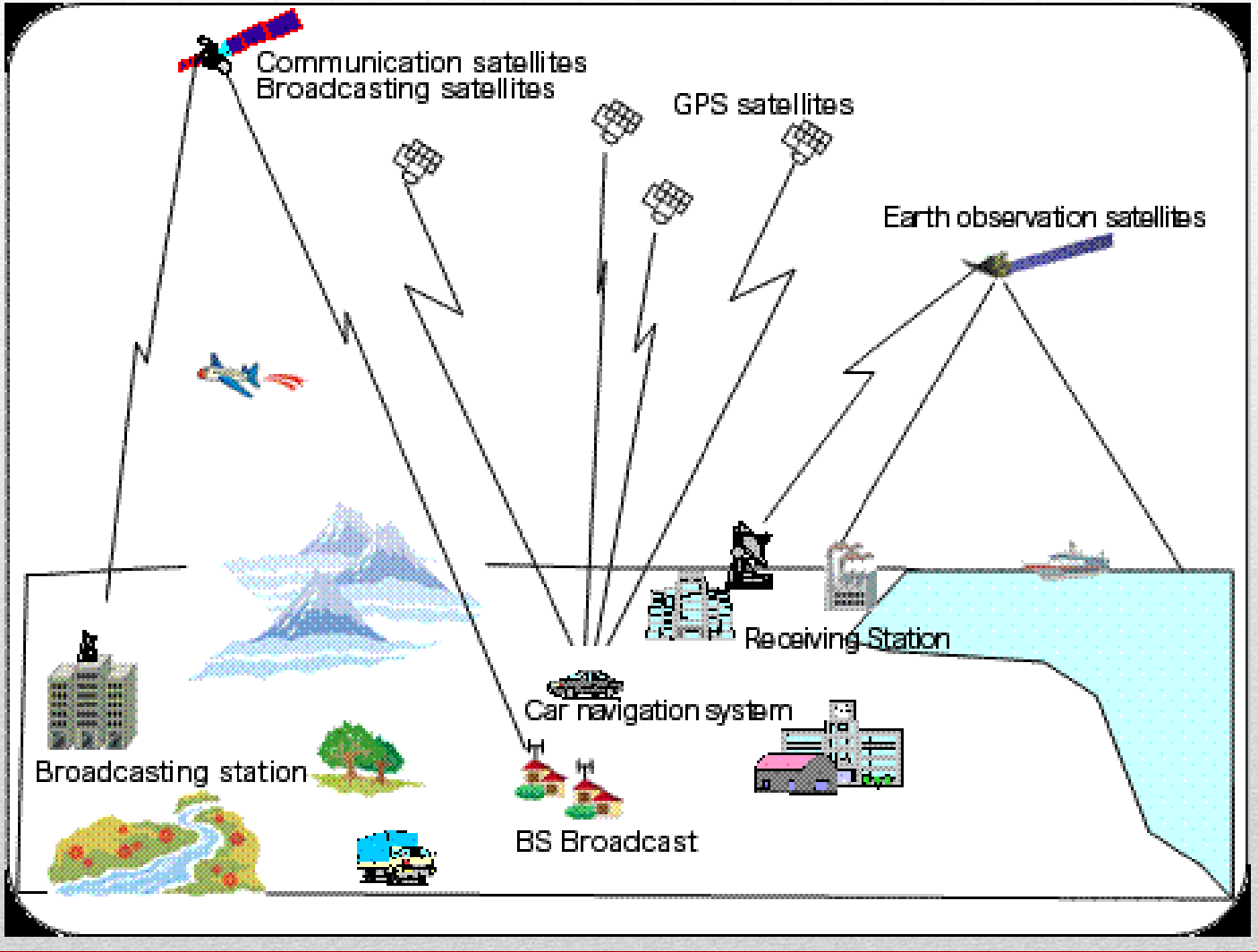




Remote Sensing

- **Any measurement or acquisition of information by a recording devise that is not in physical contact with the object under study-in this case the Earth.**
  - **Satellite remote sensing**
    - Imagery obtained from geosynchronous orbit satellites.
  - **Aerial Photographs**
    - Photographs taken from an elevated platform, such as a balloon, airplane or rocket.
    - Photographs classified either oblique or vertical.

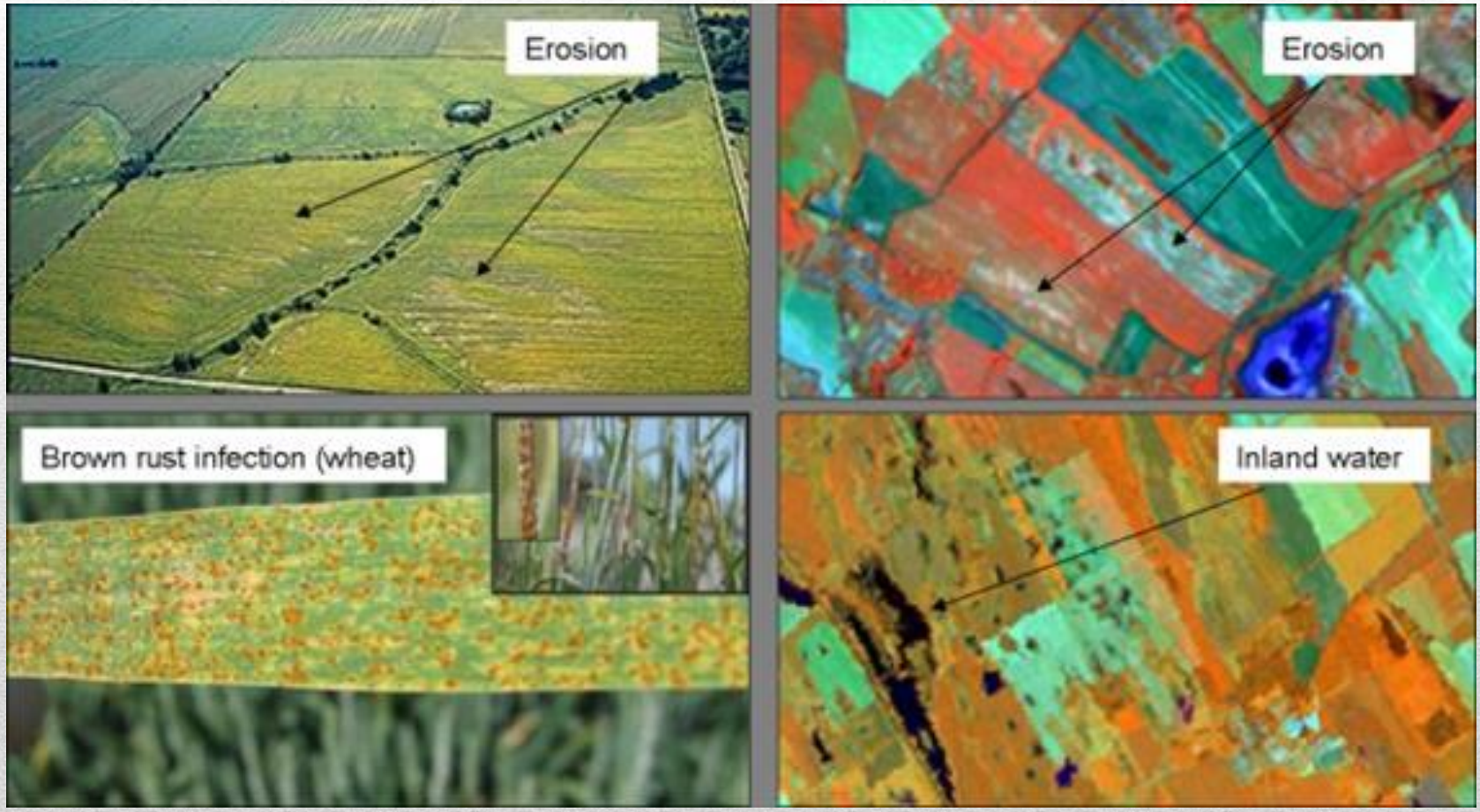
Remote Sensing



Multi-spectral Remote Sensing

- **Multi-spectral or Multi-band** – different regions of the electromagnetic spectrum
  - Landsat imagery
    - Launched in the 1970's and 1980's
      - Four spectral bands
- **Earth Observing System** (EOS)
  - Moderate Resolution Imagery Spectroradiometer (MODIS)
    - 36 spectral bands
- **Radar and Sonar Sensing**

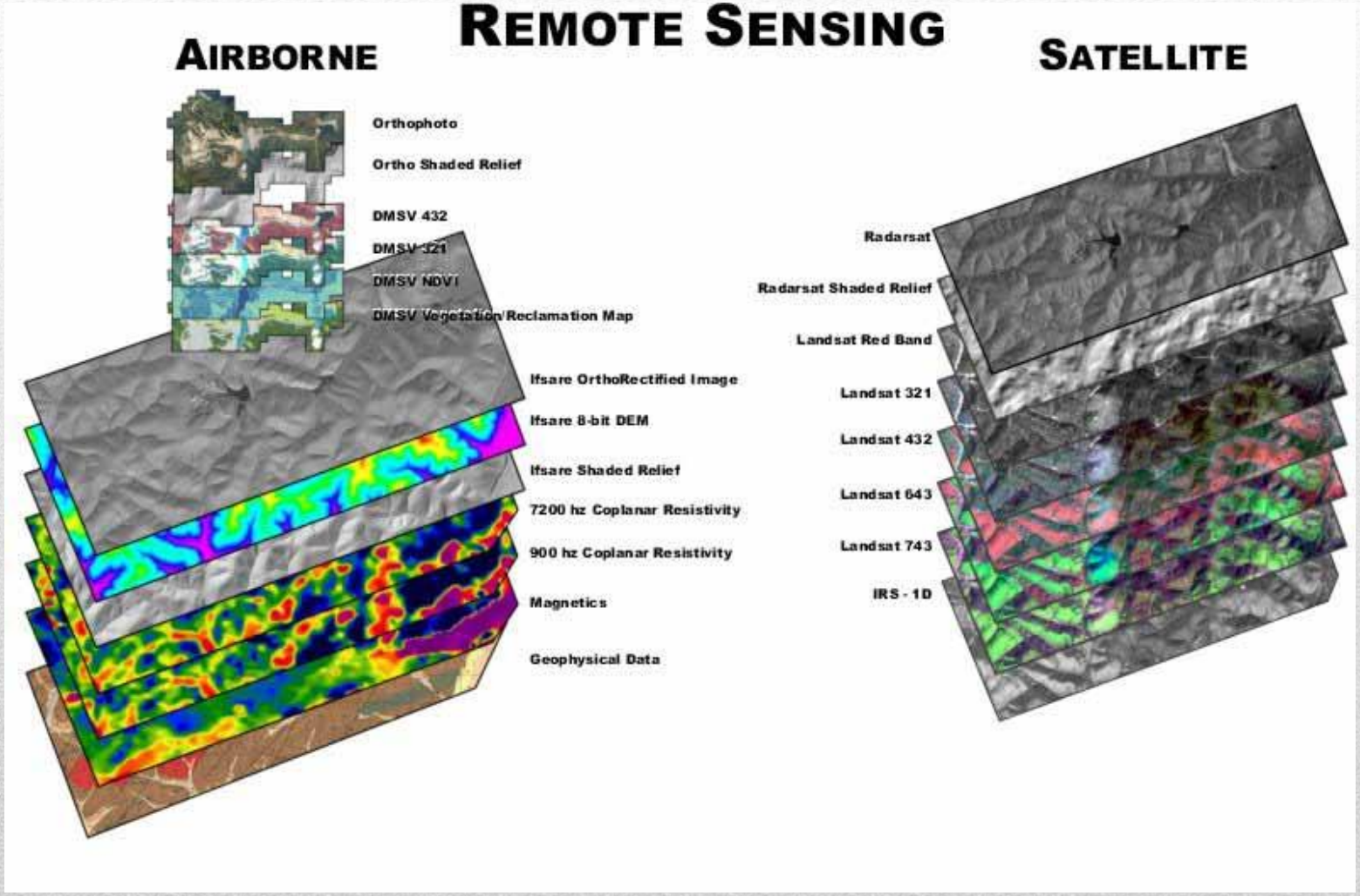
Multi-spectral Remote Sensing



Imagery

- **Orthophoto Maps** – multicolored, distortion-free photographic image maps.
  - All displacement caused by camera tilt or differences is removed.
  - Shows greater detail than a conventional map but retains the characteristic of a map
- **Color or Near Infrared Imagery**
  - Refers to the visible-light region of the electromagnetic spectrum
  - Near Infrared Color is used to depict vegetation
- **Thermal Infrared Sensing** – depicts temperature

Imagery


REMOTE SENSING
AIRBORNE
SATELLITE
Orthophoto
Ortho Shaded Relief
DMSV 432
DMSV 321
DMSV NDVI
DMSV Vegetation/Reclamation Map
Ifsare OrthoRectified Image
Ifsare 8-bit DEM
Ifsare Shaded Relief
7200 hz Coplanar Resistivity
900 hz Coplanar Resistivity
Magnetics
Geophysical Data
Radarsat
Radarsat Shaded Relief
Landsat Red Band
Landsat 321
Landsat 432
Landsat 643
Landsat 743
IRS - 1D

Geographic Information Systems (GIS)

- Automated system for **the capture, storage, retrieval, analysis, and display** of spatial data.
- A GIS can **manipulate rows and columns of tabular and links it to the spatial features** it represents.
- **All the features depicted in the GIS have a coordinate system that ties them to a coordinate system of the earth**
  - Knows where it is on the earth's surface
- Allows for the **many layers of different features to be over-laid to form maps** that can be used to make decisions.

Geographic Information Systems (GIS)